

# Assessing influence of some meteorological parameters on airborne particulate matters in the Himalayan hill-station of Darjeeling - A preliminary assessment

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1

## 1 Introduction

Airborne particulate matters are known to pose serious threat to public health in addition to its role in influencing the climate system. In the past few decades efforts have been made to assess its level in ambient air in different parts of the globe. Influence of several atmospheric parameters on the concentration of particulate matters in ambient air has also been studied in different parts of the world [1-5]. Here we study influence of such few atmospheric parameters on the level of RPM concentration in hill station of Darjeeling. We performed correlation studies among RSPM concentration and selected atmospheric parameters. We also performed stepwise multiple regression analysis taking RSPM concentration as dependent variable to develop statistical model. We analyzed the data taken for an entire year first as a whole and then season wise.

## 2 Data and methodology

We used data collected in Darjeeling (  $27.0500^{\circ}$  N,  $88.2667^{\circ}$  E, average altitude from sea level 2050 meter), situated in the eastern part of Himalaya in India, for a whole year (February 2012- January 2013). Atmospheric parameters have been provided by a automatic weather station. The number of data points we have is sufficient only for preliminary assessment. We have analyzed influence of atmospheric parameters like surface temperature, atmospheric pressure, wind speed and relative humidity on concentration of RSPM at first as whole and then as per prominent seasons as witnessed in India. We divided our data into different subsets according to seasons in order to undertake our study. We have only used those data points for which all the atmospheric parameters are available.

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<sup>1</sup>Disclaimer: This paper involves contribution from other scientists, their names will appear in the final manuscript  
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Season	Month
Winter	December - February
Premonsoon	March - may
Monsoon	June - September
Postmonsoon	October - November

Table 1: Monthwise prominent seasons in India

Seasons/ Variables	Overall		Winter		Pre-monsoon		Monsoon		Post-monsoon	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
RSPM	33.88	22.07	45.54	22.11	41.02	21.08	20.77	18.59	25.70	15.41
Temperature	11.50	4.59	5.77	1.83	13.13	3.02	16.40	0.91	10.01	2.45
Relative Humidity	80.71	36.15	75.34	15.20	74.74	14.08	92.83	3.18	78.19	9.44
Atmospheric Pressure	781.42	13.62	781.93	1.96	780.89	2.63	780.09	2.67	784.15	1.53
Wind Speed	0.93	0.38	0.79	0.22	1.33	0.45	0.77	0.25	0.76	0.13

Table 2: Mean and standard deviation of RSPM concentration and some meteorological parameters in different seasons in Darjeeling (SD stands for standard deviation)

## 2.1 Stepwise Regression

Multiple linear regression(MLR) has been widely used by many authhors in the field of air pollution. Multiple linear regression has the form like

$$Y = C_0 + C_1X_1 + C_2X_2 + C_3X_4 + ....$$

Here,  $Y$  is the dependent variable and  $X_i$ 's are predictor variables.  $C_i$ 's are coefficients of regression. In stepwise linear regression one performs simple MLR of all the predictor variables. If all the predictor variables found significant then the total model is good. Otherwise simple one variable linear regression is performed with each of the predictor variables, and variable which gives lowest p-value for t-test, is chosen. Then two-variable regression is performed taking the chosen variable in the previous step as common. In this way predictor variables are added in the model in each step (i.e., stepwise) as long as all the variables in the model are found significant.

## 3 Results and Discussion

In Table 1 we have compared RSPM concentration ( $\mu g/m^3$ ) and different atmospheric parameters among different seasons. Observation shows during winter our study site recorded highest RSPM concentration (Fig 1). In Table 2 we presented Pearson's correlation co-efficient along with p-value between atmospheric parameters and RSPM concentration for different seasons. We also presented the statistical model as derived by stepwise multiple regression method. Our result clearly shows that in our study site temperature and atmospheric pressure are strong negatively correlated ( $p < 0.05$ ) with RSPM concentration in most of the seasons. However wind speed and relative humidity show negative and positive correlation respectively with RSPM concentration for just one season only.

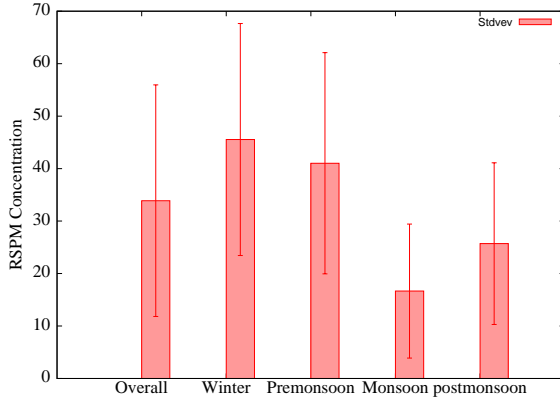


Figure 1: Season wise concentration of RSPM.

Sesn.	Prmtr.	Corr.	P-val	Statistical Model	$R^2$
Overall	Temp	-0.45	0.00	RSPM=1782.60 - 2.43 x Temp - 2.2 x Atmos_prsr	0.26
	RH	-0.04	0.73		
	Atmos. Prsr.	-0.16	0.13		
	wind Spd	0.09	0.42		
Winter	Temp	0.14	0.51	RSPM=2892.68 + 0.9831 x RH - 3.76 x Atmos_prsr + 3.74 x Temp	0.67
	RH	0.71	0.00		
	Atmos Prsr	-0.44	0.04		
	Wnd Spd	-0.10	0.64		
Pre-monsoon	Temp	-0.41	0.04	RSPM=74.80 - 2.63 x Temp	0.17
	RH	-0.09	0.65		
	Atmos Prsr	0.08	0.72		
	Wnd Spd	-0.17	0.39		
Monsoon	Temp	0.10	0.66	None of the parameters found significant	
	RH	0.16	0.44		
	Atmos Prsr	-0.41	0.04		
	Wnd Spd	0.15	0.49		
Post-monsoon	Temp	-0.59	0.01	RSPM=4536.24 - 68.35 x Wnd_spd - 5.69 x Atmos_prsr	0.69
	RH	0.44	0.08		
	Atmos Prsr	-0.59	0.01		
	Wnd Spd	-0.51	0.04		

Table 3: Correlation (Pearson's) among different atmospheric parameters and RSPM concentration and statistical model as derived by stepwise multiple regression method with  $R^2$ .

Our statistical model performs very well during winter and post-monsoon seasons yielding  $R^2$  value (coefficient of determination) 0.67 and 0.69 respectively indicating almost seventy percent of the variability in RSPM concentration can be attributed to several atmospheric parameters. In the season of monsoon none of the atmospheric parameters is significantly correlated to RSPM concentration. As declared in the beginning, given the size of the data sample, this study should be considered as preliminary investigation however our efforts are on towards further detailed study in this direction.

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